IN THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

1. (Withdrawn) Cargo loss detection apparatus for a liquid cargo container and comprising:

first and second parallel vertical pipes,

the first pipe having a lower end adapted for submersion in liquid cargo in the container, and said first pipe having a valve which can be opened to admit cargo from the container into the first pipe for movement of a portion of the cargo upward in the first pipe to the level of the surface of the cargo around the first pipe outside of the pipe, and the valve being operable when actuated to close to prevent movement of cargo out of the first pipe when the level of the surface of the cargo around the first pipe decreases,

the second pipe having a lower end adapted for submersion in the said liquid cargo in the container and the second pipe being adapted to admit a portion of the cargo to flow upward into said second pipe to the said level of the surface of the cargo around the first pipe;

a first float in said first pipe and having a first magnet;

a second float in said second pipe and having a second magnet;

first and second parallel vertical tubes received through said first and second floats, respectively, each of said floats being floatable on the portion of the cargo in the pipe in which the float is located, and each float being movable lengthwise of the said tube received through the float;

first and second float followers located in said first and second tubes and movable lengthwise in said first and second tubes, respectively;

third and fourth magnets connected to said first and second float followers, respectively, and magnetically suspended by said first and second magnets, respectively, whereby said float followers are suspended in their respective tubes by said floats;

first and second float follower level recognition devices atop said first and second tubes, respectively, to establish a float relationship reference when both floats have reached a stabilized relationship in cargo admitted to the same level in both pipes, and to sense a variation from said relationship reference in response to a change from said stabilized relationship when cargo has been lost from said container; and

a comparator coupled to said recognition devices and responsive to a sensed variation from said relationship reference.

2-50. (Canceled.)

51. (Previously Presented) Liquid level measurement apparatus for liquid in a holder and comprising:

a holder for containing liquid;

a vertical pipe secured to said holder, said pipe being arranged for at least partial submersion in said liquid;

a target in said pipe and arranged to rise and fall in synchronism with rise and fall of the surface of liquid in said holder;

a laser for transmitting signals longitudinally in the pipe to impinge on said target in the pipe to be reflected by said target back to said laser;

a computer coupled to said laser to compare time of transmission of said signals by said laser, with time of reception by said laser of said signals reflected back by said target, and determine the level of the surface of said liquid in said holder;

a signal transmission tube coupled to said laser for said signals transmitted by said laser into said pipe;

said pipe having a receiver arranged to receive said transmission tube for providing a passageway for signals produced by said laser, from said laser through said pipe to said target and for return of said laser signals reflected by said target, from said target to said laser;

said signal transmission tube and said receiver are configured to mate for establishing collinear axes of said transmission tube and said pipe for transmission of signals produced by said laser on said axis, from said laser to said target; and

said transmission tube and said receiver are configured to mate by sliding said tube and said receiver together.

52. (Original) The apparatus of claim 51 and wherein:

said transmission tube has a lower end and an upper end; and

said receiver has an upwardly opening socket to receive a portion of said tube adjacent said lower end of said tube to facilitate coupling said carrier to said pipe for transmission and reception of said laser signals, and for de-coupling said carrier from said pipe for transporting to another liquid holder.

53. (Previously Presented) Liquid level measurement apparatus for liquid in a holder and comprising:

a holder for containing liquid;

a vertical pipe secured to said holder, said pipe being arranged for at least partial submersion in said liquid;

a target in said pipe and arranged to rise and fall in synchronism with rise and fall of the surface of liquid in said holder;

a laser for transmitting signals longitudinally in the pipe to impinge on said target in the pipe to be reflected by said target back to said laser;

a computer coupled to said laser to compare time of transmission of said signals by said laser, with time of reception by said laser of said signals reflected back by said target, and determine the level of the surface of said liquid in said holder;

a signal transmission tube coupled to said laser for said signals transmitted by said laser into said pipe;

said pipe having a receiver arranged to receive said transmission tube for providing a passageway for signals produced by said laser, from said laser through said pipe to said target and for return of said laser signals reflected by said target, from said target to said laser;

a carrier coupled to said laser for lifting said laser from said receiver on said liquid holder following measurement of the level of the surface of liquid in said holder, and for carrying said laser to a receiver like said first-mentioned receiver but located on another liquid holder to measure the level of the surface of a liquid in said another liquid holder; and

a pipe cover pivotally mounted to said holder to pivot from a first, receiver-covering orientation, to a second orientation enabling access to said receiver for receiving said transmission tube.

54. (Previously Presented) The apparatus of claim 53 and further comprising:

a code on the inside of said cover for identifying the holder to which said cover is mounted; and

a code reader mounted to said carrier for reading said code when said transmission tube is received in said receiver.

55. (Previously Presented) The apparatus of claim 54 and further comprising:

a stop on said carrier and positioned to support said cover in position for reading said code by said code reader when said transmission tube is received by said receiver.

56. (Previously Presented) Liquid level measurement apparatus for liquid in a holder and comprising:

a holder for containing liquid;

a vertical pipe secured to said holder, said pipe being arranged for at least partial submersion in said liquid;

a target in said pipe and arranged to rise and fall in synchronism with rise and fall of the surface of liquid in said holder;

a laser for transmitting signals longitudinally in the pipe to impinge on said target in the pipe to be reflected by said target back to said laser;

a computer coupled to said laser to compare time of transmission of said signals by said laser, with time of reception by said laser of said signals reflected back by said target, and determine the level of the surface of said liquid in said holder;

a signal transmission tube coupled to said laser for said signals transmitted by said laser into said pipe;

said pipe having a receiver arranged to receive said transmission tube for providing a passageway for signals produced by said laser, from said laser through said pipe to said target and for return of said laser signals reflected by said target, from said target to said laser;

an ultrasonic signal transducer;

a second signal transmission tube, said second tube being coupled to said ultrasonic signal transducer, and

said second tube being receivable by said receiver for providing a passageway for ultrasonic signals produced by said transducer, from said transducer through said pipe to said target and for return of said ultrasonic signals reflected by said target, from said target to said transducer.

57. (Previously Presented) The apparatus of claim 56 and wherein:

said computer is coupled to said transducer to compare time of transmission of said ultrasonic signals by said transducer with time of receipt by said transducer of said ultrasonic signals reflected from said target to provide a measurement representative of the level of the surface of the liquid in the holder, and compare the level measured by the laser to the level as indicated by the transducer, and apply a temperature compensation

factor to the level measurement by the transducer to match the level measurement by the laser, and output the temperature corresponding to said compensation factor that achieves the match.

58. (Previously Presented) The apparatus of claim 57 and further comprising:

a display representing measurement of the level of the surface of the liquid in the holder and the temperature of said atmosphere.

59. (Previously Presented) The apparatus of claim 57 and further comprising:

a second vertical pipe secured to said holder, said second pipe being arranged for at least partial submersion in said liquid;

a second target, said second target being located in said second pipe and arranged to rise and fall in synchronism with rise and fall of the surface of the liquid in said holder;

said second pipe having a receiver to receive said second signal transmission tube for providing a passageway for signals produced by said transducer, from said transducer to said second target, and for return of said transducer signals reflected by said target, from said target to said transducer.

60. (Previously Presented) The apparatus of claim 56 and wherein:

said transducer is mounted atop said second signal transmission tube.

61. (Previously Presented) Liquid level measurement apparatus for liquid in a holder and comprising:

a holder for containing liquid;

a vertical pipe secured to said holder, said pipe being arranged for at least partial submersion in said liquid;

a target in said pipe and arranged to rise and fall in synchronism with rise and fall of the surface of liquid in said holder;

a laser for transmitting signals longitudinally in the pipe to impinge on said target in the pipe to be reflected by said target back to said laser;

a computer coupled to said laser to compare time of transmission of said signals by said laser, with time of reception by said laser of said signals reflected back by said target, and determine the level of the surface of said liquid in said holder;

an ultrasonic transducer coupled to said signal transmission tube and oriented to project ultrasonic signals down through the tube and pipe and receive ultrasonic radiation up through the pipe; and wherein:

said laser is oriented to transmit signals horizontally through an opening in said pipe;

a reflector is provided on said pipe and oriented to reflect laser signals received horizontally and transmit said signals vertically down through said pipe, and receive signals reflected from said target up through the pipe and reflect the signals horizontally into the said laser; and wherein

said computer is coupled to said transducer to compare time of transmission of said ultrasonic signals by said transducer with time of receipt by said transducer of said

ultrasonic signals reflected from said target to provide a measurement representative of the level of the surface of the liquid in the holder, and compare the level measured by the laser to the level represented by the transducer measurement, and apply a temperature compensation factor to the level measurement by the transducer to match the level measurement by the laser, and output the temperature corresponding to said compensation factor that achieves the match.

62. (Previously Presented) The apparatus of claim 61 and wherein:

said reflector projects into said pipe from a side wall of said pipe and has a laser reflecting surface disposed at about 45 degrees from the path of a beam from the laser to reflect the laser beam downward along the axis of the pipe.

63. (Previously Presented) The apparatus of claim 61 and wherein:

said reflector is pivotally mounted to the wall of said pipe and is received in a recess in said wall for facilitating ultrasonic transmission of signals along the axis of said pipe; and wherein:

said reflector is pivotal into said pipe to a position disposed at about 45 degrees from the path of a beam from the laser to reflect the laser beam downward along said axis of said pipe.

64. (Previously Presented) The apparatus of claim 61 and wherein:

said reflector is pivotally mounted in the pipe for orientation of a reflecting surface of the reflector from a plane containing the axis of the pipe to a plane at a 45 degree angle to said plane to reflect a beam from the laser downward along the axis.

65. (Withdrawn) A method of measuring the level of liquid in a tank and comprising:

mounting a laser on the tank;

transmitting signals from the laser vertically down a pipe fixed to the tank onto a target which rises and falls according to the level of the surface of said liquid in the tank;

reflecting the signals from the target up the pipe to reception by the laser; and

using the elapsed time period from transmission to reception to measure the level of said liquid.

66. (Withdrawn) The method of claim 65 and further comprising:

using the surface of said liquid as said target.

67. (Withdrawn) The method of claim 65 and further comprising:

using a float in said liquid to cause the target to rise and fall according to the level of said liquid.

68. (Withdrawn) The method of claim 67 and further comprising:

locating said target inside said pipe;

locating said float outside said pipe; and

magnetically coupling said target to said float.

69. (Withdrawn) The method of claim 67 and further comprising:

moving the laser from said tank to other tanks in sequence for measuring the levels of liquids in said other tanks.

70. (Withdrawn) The method of claim 67 and further comprising:

mounting an ultrasonic signal transducer on the tank;

transmitting signals from said transducer vertically down said pipe fixed to the tank onto said target;

reflecting the ultrasonic signals from the target up the pipe to reception by the transducer;

using the elapsed time period from transmission to reception of said ultrasonic signals to measure the level of said liquid;

comparing the level measurement by transducer with the level measurement by the laser; and

applying temperature influenced sound velocity compensation numbers to the measurement by the transducer to adjust the measurement by the transducer to match that by the laser, and providing the temperature number that achieves the match.

71. (Withdrawn) The method of claim 65 and further comprising:

mounting an ultrasonic signal transducer on the tank;

transmitting signals from said transducer vertically down a second pipe fixed to the tank onto a target in said second pipe;

reflecting the ultrasonic signals from the second target up the second pipe to reception by the transducer;

using the elapsed time period from transmission to reception of said ultrasonic signals by said transducer to measure the level of said liquid;

comparing the level measurement by said transducer with the level measurement by said laser; and

applying temperature influenced sound velocity compensation numbers to the measurement by the transducer to adjust the level measurement by the transducer to match the level measurement by the laser, and displaying the temperature number that achieves the match.

72. (Withdrawn) The method of claim 71 and further comprising:

exposing said pipes to said laser and ultrasonic transducer by raising a cover movably connected to the tank and carrying said laser and transducer simultaneously to the tank and coupling said laser and said transducer to said pipes.

73. (Withdrawn) The method of claim 72 and further comprising:

providing a tank-identifying machine-readable code on said cover; and

exposing said code to a code reader when said laser and transducer are coupled to said pipes to relate the level measurements to the tank where the measurements are made.

74-78. Cancelled.